

LISTING OF THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Withdrawn) An optical transmission system, comprising:

one or more first light sources for Raman amplification that amplify signal light transmitting in an optical transmission line; and

one or more second light sources for Raman amplification that are disposed at the positions adjoining said one or more first light sources for Raman amplification via said optical transmission line, wherein:

each of said one or more first light sources for Raman amplification, comprising:

a first pumping light source that emits first pumping light at a normal time as a pumping light source; and

a first optical multiplexer that inputs said first pumping light to said optical transmission line, and

each of said one or more second light sources for Raman amplification, comprising:

a second pumping light source that emits second pumping light of the same wavelength band of said first pumping light at a normal time as a pumping light source;

a spare pumping light source that emits spare pumping light of the same wavelength band of said first pumping light based on necessity;

an optical coupler that couples said second pumping light and said spare pumping light; and

a second optical multiplexer that inputs said coupled pumping light to said optical transmission line, wherein:

in case that a failure occurred at said first or second pumping light source, said spare pumping light source is worked and said spare pumping light is emitted.

2. (Withdrawn) An optical transmission system, comprising:

one or more first light sources for Raman amplification that amplify signal light transmitting in an optical transmission line; and

one or more second light sources for Raman amplification that are disposed at the positions adjoining said one or more first light sources for Raman amplification via said optical transmission line, wherein:

each of said one or more first light sources for Raman amplification, comprising:

plural first pumping light sources that emit plural first pumping light whose wavelengths are different from each other at a normal time, as pumping light sources;

a first optical multiplexer that multiplexes said plural first pumping light; and

a second optical multiplexer that inputs said multiplexed first pumping light to said optical transmission line, and

each of said one or more second light sources for Raman amplification, comprising:

plural second pumping light sources that emit plural second pumping light whose wavelengths are the same ones corresponding to said plural first pumping light sources at a normal time, as pumping light sources;

plural spare pumping light sources that emit plural spare pumping light whose wavelengths are the same ones corresponding to said plural second pumping light sources based on necessity;

plural optical couplers that couple said second pumping light and said spare pumping light of the same wavelength band;

a third optical multiplexer that multiplexes plural coupled pumping light whose wavelengths are different from each other; and

a fourth optical multiplexer that inputs multiplexed pumping light to said optical transmission line, wherein:

in case that a failure occurred at one in said plural first or plural second pumping light sources, said spare pumping light source whose wavelength band is the same one that said failure occurred is worked and said spare pumping light is emitted.

3. (Withdrawn) An optical transmission system in accordance with claim 1, wherein:

in case that a failure occurred at said first or second pumping light source, said spare pumping light is emitted from said spare pumping light source so that the output level of said signal light becomes the same output level before said failure occurred.

4. (Withdrawn) An optical transmission system in accordance with claim 2, wherein:
in case that a failure occurred at one in said plural first or plural second pumping light sources, said spare pumping light is emitted from corresponding one of said plural spare pumping light sources so that the output level of said signal light becomes the same output level before said failure occurred.

5. (Withdrawn) An optical transmission system in accordance with claim 1, wherein:
in case that a failure occurred at said first or second pumping light source, said spare pumping light is emitted from said spare pumping light source so that the gain wavelength characteristic of said signal light becomes the same gain wavelength characteristic before said failure occurred.

6. (Withdrawn) An optical transmission system in accordance with claim 2, wherein:
in case that a failure occurred at one in said plural first or plural second pumping light sources, said spare pumping light is emitted from corresponding one of said plural spare pumping light sources so that the gain wavelength characteristic of said signal light becomes the same gain wavelength characteristic before said failure occurred.

7. (Withdrawn) An optical transmission system in accordance with claim 1, wherein:
each of said one or more first light sources for Raman amplification, further comprising:
a control circuit that controls said first pumping light source, and
each of said one or more second light sources for Raman amplification, further comprising:
a control circuit that controls said second pumping light source and said spare pumping light source.

8. (Withdrawn) An optical transmission system in accordance with claim 2, wherein:
each of said one or more first light sources for Raman amplification, further comprising:
a control circuit that controls said plural first pumping light sources, and
each of said one or more second light sources for Raman amplification, further comprising:
a control circuit that controls said plural second pumping light sources and said plural spare pumping light sources.

9. (Withdrawn) An optical transmission system, comprising:

one or more light sources for Raman amplification not having a redundancy system that amplify signal light transmitting in plural optical transmission lines; and

one or more light sources for Raman amplification having a redundancy system that are disposed at the positions adjoining said one or more light sources for Raman amplification not having said redundancy system via said plural optical transmission lines, wherein:

each of said one or more light sources for Raman amplification not having said redundancy system, comprising:

plural first pumping light sources that emit first pumping light whose wavelengths are different from each other at a normal time, as pumping light sources;

a first means that multiplexes said plural first pumping light and splits multiplexed pumping light into plural pumping light; and

plural first optical multiplexers that input split pumping light to said plural optical transmission lines, and

each of said one or more light sources for Raman amplification having said redundancy system, comprising:

plural second pumping light sources that emit second pumping light whose wavelengths are the same ones of said plural first pumping light sources at a normal time, as pumping light sources;

plural spare pumping light sources that emit spare pumping light whose wavelength bands are the same ones corresponding to said plural first pumping light sources, based on necessity;

plural optical couplers that couple said second pumping light and said spare pumping light of the same wavelength band;

a second means that multiplexes plural coupled pumping light whose wavelengths are different from each other and splits multiplexed pumping light into plural pumping light; and

plural second optical multiplexers that input split pumping light to said plural optical transmission lines, wherein:

in case that a failure occurred at one in said plural first pumping light sources in said one or more light sources for Raman amplification not having said redundancy system or at one in said plural second pumping light sources in said light sources for Raman amplification having said

redundancy system, said spare pumping light source whose wavelength band is the same one that said failure occurred is worked and said spare pumping light is emitted.

10. (Withdrawn) An optical transmission system, comprising:

one or more light sources for Raman amplification not having a redundancy system that amplify signal light transmitting in plural optical transmission lines; and

one or more light sources for Raman amplification having a redundancy system that are disposed at the positions adjoining said one or more light sources for Raman amplification not having said redundancy system via said plural optical transmission lines, wherein:

each of said one or more light sources for Raman amplification not having said redundancy system, comprising:

plural first pumping light sources that emit first pumping light whose wavelengths are different from each other at a normal time, as pumping light sources;

a first means that multiplexes said plural first pumping light and splits multiplexed pumping light into plural pumping light; and

plural first optical multiplexers that input split pumping light to said plural optical transmission lines, and

each of said one or more light sources for Raman amplification having said redundancy system, comprising:

plural second pumping light sources that emit second pumping light whose wavelengths are the same ones of said plural first pumping light sources at a normal time, as pumping light sources;

plural spare pumping light sources that emit spare pumping light whose wavelength bands are the same ones corresponding to said plural first pumping light sources, based on necessity;

plural optical multiplexers that multiplex said second pumping light having different wavelengths in one of said plural optical multiplexers and multiplex said spare pumping light having different wavelengths in other of said plural optical multiplexers;

a second means that multiplexes plural multiplexed pumping light whose wavelengths are different from each other and splits multiplexed pumping light into plural pumping light; and

plural second optical multiplexers that input split pumping light to said plural optical transmission lines, wherein:

in case that a failure occurred at one in said plural first pumping light sources in said one or more light sources for Raman amplification not having said redundancy system or at one in said plural second pumping light sources in said light sources for Raman amplification having said redundancy system, said spare pumping light source whose wavelength band is the same one that said failure occurred is worked and said spare pumping light is emitted.

11. (Previously Presented) An optical amplification method for an optical transmission system including a plurality of first light sources for Raman amplification that amplify signal light transmitted in an optical transmission line and a plurality of second light sources for Raman amplification that are disposed at positions adjoining respective ones of said plurality of first light sources for Raman amplification via said optical transmission line, comprising the steps of:

amplifying said signal light by said first light sources for Raman amplification;

transmitting said amplified signal light through said optical transmission line;

providing one or more spare pumping light sources only in said plurality of second light sources for Raman amplification, the number of said second light sources being less than the number of said first light sources, a number of said first light sources not having spare pumping light sources, intervening between two of said second light sources being determined by a permissible failure rate of the optical transmission system;

detecting a deteriorated state of said signal light amplified by one or more of said first sources for Raman amplification; and

restoring said deteriorated signal light to an un-deteriorated state by emitting spare pumping light from at least one of said spare pumping light sources,

said spare pumping light sources being operated only when required to restore deteriorated signal light.

12. (Previously Presented) An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

responsive to a deteriorated state of said amplified signal light, said spare pumping light is emitted from said spare pumping light source so that the output level of said signal light becomes the same output level before said deterioration.

13. (Previously Presented) An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

responsive to a deteriorated state of said amplified signal light, said spare pumping light is emitted from said spare pumping light source so that the gain wavelength characteristic of said signal light becomes the same gain wavelength characteristic before said deterioration.

14. (Previously Presented) An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

said first and second light sources emit light at first and second wavelengths, and
at least one spare pumping light source is provided for each of said first and second wavelengths.

15. (Original) An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

outputs from said pumping light source and said spare pumping light source are controlled by respective control circuits in said one or more first and second light sources for Raman amplification.

16. (Previously Presented) An optical amplification method for an optical transmission system including a plurality of first light sources for Raman amplification for amplifying signal light transmitted in an optical transmission line and a plurality of second light sources for Raman amplification for amplifying signal light transmitted in said optical transmission line, wherein ones of said plurality of second light sources for Raman amplification are disposed at positions adjoining respective ones of said first light sources for Raman amplification, said method comprising the steps of:

amplifying said signal light at first and second wavelengths by at least one of the plurality of said first Raman amplifiers;

transmitting, by the at least one of the plurality of said first Raman amplifiers, said amplified signal light through said optical transmission line;

providing, only in said plurality of second light sources for Raman amplification, a first spare pumping light source operating at a first wavelength for Raman amplification, and a second spare pumping light source operating at a said second wavelength for Raman amplification;

detecting a deteriorated state of said signal light in said optical transmission line at said first wavelength, and/or said second wavelength; and

restoring said deteriorated signal light to an un-deteriorated state by operating said first or second spare pumping light sources,

said first and second spare pumping light sources being operated only when required to restore deteriorated signal light at their respective operating wavelengths, a total number of said first light sources for Raman amplification and a total number of said second light sources for Raman amplification being determined by a permissible failure rate of the optical transmission system.